



## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference F18022 GSK	<b>FOR FURTHER ACTION</b>		See Form PCT/PEA/416
International application No. PCT/B2004/002243	International filing date (day/month/year) 09.07.2004	Priority date (day/month/year) 15.07.2003	
International Patent Classification (IPC) or national classification and IPC B01J8/22			
Applicant SASOL TECHNOLOGY (PROPRIETARY) LIMITED et al.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 5 sheets, as follows:</p> <p style="margin-left: 40px;"><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p style="margin-left: 40px;"><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>			
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>			
Date of submission of the demand  20.04.2005		Date of completion of this report  31.10.2005	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Thomasson, P  Telephone No. +49 89 2399-8339 	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/IB2004/002243

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1-19 as originally filed

**Claims, Numbers**

1-26 received on 25.04.2005 with letter of 20.04.2005

**Drawings, Sheets**

1/2, 2/2 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
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International application No.  
PCT/IB2004/002243

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-26
	No: Claims	
Inventive step (IS)	Yes: Claims	1-26
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-26
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement

1. Reference is made to the following documents:

D1: US-A-5 527 473

D2: WO03/047741

2. The present application **meets** the requirement of Article 33(2)-(3) PCT:

- 2.1 Closest prior art

D1 and D2, considered as being equivalent closest prior arts, disclose a process for producing a **liquid** with a **gas** reacting **upwardly** in a liquid/catalyst **slurry**. The liquid product is withdrawn through a **primary filtration stage** (separation of catalyst particles) followed by a **second filtration stage** for separating the fine catalyst particles from the liquid product. Furthermore the **filtrate** of the **second** filtration stage, which does not contain fine particles any more, is **back-flushed** through the filter of the **first** filtration stage in order to **dislodge** the cake from the filter (see D1 and D2: International Search Report).

- 2.2 Novelty

The subject-matter of claim 1 differs from D1 and D2 in that (1) during the primary filtration stage the catalyst particles having a size from 1 micron to the size of the filter pores ("near-size" catalyst particles) and the fine catalyst particles (less than 1 micron) are collected in a primary filtrate and in that (2) this primary filtrate is subjected to a second filtration stage for separating the "near-size" catalyst particles from the fine catalyst particles. The second filtrate containing liquid and the fine catalyst particles is used for back-flushing the filter medium of the primary filtration stage.

- 2.3 Inventive step

The technical problem to be solved against D1 and D2 is to effectively reduce the irreversible blinding of the filter medium of the primary filtration stage during back-flushing. This problem is solved by using a liquid containing only fine catalyst particles (size less than 1 micron) for the back-flushing solution. D1 and D2 disclose that all catalyst particles are removed after the second filtration stage; D1 and D2 do not disclose to separate the "near-size" catalyst particles from the fine catalyst particles. In accordance with the process of claim 1 it is not necessary to separate the fine catalyst particles from the secondary filtrate. This would lead to a cost-effective process since it can be very costly to separate fine catalyst particles from a liquid product (high pressure drops, frequent replacement of filter cartridges...). The inventive step can therefore be recognized.

CLAIMS:

1. A process for producing liquid and, optionally, gaseous products from gaseous reactants, which process includes

5 feeding, at a low level, gaseous reactants into a slurry bed of solid catalyst particles suspended in a suspension liquid;

allowing the gaseous reactants to react as they pass upwardly through the slurry bed, thereby to form liquid and, optionally, gaseous products, with the reaction being catalyzed by the catalyst particles and with a product  
10 mixture comprising liquid product and catalyst particles having a range of sizes, being formed;

subjecting, in a primary filtration stage, the product mixture to primary filtration by passing the liquid product through a filtering medium having a plurality of filtering openings through which the liquid product passes, with the  
15 liquid product passing through the filtering openings in a first direction and with the filtering openings having a controlling dimension of  $x$  microns, so that large catalyst particles having a particle size greater than  $x$  microns are separated from the liquid product, thereby to obtain a primary filtrate comprising liquid product, near-size catalyst particles that range in size from 1  
20 micron to  $x$  microns, and fine catalyst particles that are smaller than 1 micron;

subjecting, in a secondary filtration stage, the primary filtrate to secondary filtration to separate the near-size catalyst particles and, optionally, some of the fine catalyst particles, from liquid product, thereby to obtain a secondary filtrate comprising liquid product and fine catalyst particles;

25 allowing a cake of catalyst particles to build up on the filtering medium in the primary filtration stage;

from time to time interrupting the passage of liquid product through the filtering medium in the primary filtration stage; and

backflushing the filtering medium by passing secondary filtrate, as a  
30 flushing liquid, through the filtering medium in a second direction, opposite to the first direction, for at least portions of the periods that the liquid product passage is interrupted, thereby to dislodge the cake from the filtering medium.

2. A process as claimed in Claim 1, wherein the suspension liquid is liquid product.
3. A process as claimed in Claim 2, wherein the hydrocarbon synthesis is Fischer-Tropsch synthesis, with the gaseous reactants being in the form of a synthesis gas stream comprising mainly carbon monoxide and hydrogen, with both liquid and gaseous hydrocarbon products being produced, and with the catalyst particles thus being Fischer-Tropsch catalyst particles.
4. A process as claimed in Claim 3, wherein the slurry bed is provided in a vessel, with unreacted reactants and gaseous product being withdrawn from the vessel above the slurry bed, and with the vessel being maintained at Fischer-Tropsch synthesis pressure and temperature conditions.
5. A process as claimed in Claim 4, wherein the catalyst is an iron-based or a cobalt-based Fischer-Tropsch catalyst.
6. A process as claimed in Claim 5, wherein the catalyst is an iron-based Fischer-Tropsch catalyst, with the controlling dimension of the filtering openings being 25 microns, with catalyst particles larger than 25 microns being filtered out in the primary filtration stage and forming the cake on the filtering medium, and with catalyst particles having sizes in the range 1 micron to 25 microns being near-size catalyst particles, while those smaller than 1 micron are fine catalyst particles.
7. A process as claimed in Claim 6, wherein the catalyst is a cobalt-based Fischer-Tropsch catalyst, with the controlling dimension of the filtering openings being 10 microns.
8. A process as claimed in any one of Claims 4 to 7 inclusive, wherein the filtering medium is part of a filter element which is mounted inside

the vessel and is of elongate form, with the filtering medium being of cylindrical form and enclosing a filtrate collecting zone, and with a filtrate outlet for withdrawing filtrate being provided at one end of the filter element.

5     9.            A process as claimed in Claim 8, wherein the primary filtration stage is located inside the slurry bed.

10     10.           A process as claimed in Claim 9, which includes providing a plurality of the filter elements, located at different levels within a filtration zone below the upper surface of the slurry bed.

15     11.           A process as claimed in Claim 10, wherein the passage of the liquid product through the filtering media is effected by applying a pressure differential across the filtering media and any cake build-up thereon.

20     12.           A process as claimed in Claim 11, wherein the pressure differential is effected by withdrawing the primary filtrate into a primary filtrate collection vessel which is at a lower pressure than the vessel, with the filtrate outlets of the filter elements being connected to the primary filtrate collection vessel by means of liquid product conduits.

13.           A process as claimed in Claim 11 or Claim 12, wherein the secondary filtration stage is located outside the vessel.

25     14.           A process as claimed in Claim 13, wherein the secondary filtration stage is provided by a vertically or horizontally orientated pressure leaf filter.

30     15.           A process as claimed in Claim 13 or Claim 14, wherein the secondary filtration stage includes filterable granular filter aid material.

16.           A process as claimed in any one of Claims 11 to 15 inclusive, wherein the backflushing is effected for at least portions of the periods that the

liquid product passage through the filtering media of the primary filtering stage is interrupted.

17. A process as claimed in Claim 16, wherein the backflushing is effected in pulse-like fashion.

18. A process as claimed in Claim 17, wherein the backflushing comprises an initial pulse of flushing liquid, followed by one or more further pulses of flushing liquid, with each backflushing pulse comprising initiating backflushing rapidly, and backflushing the elements rapidly with a volume of the flushing liquid.

19. A process as claimed in Claim 18, wherein the volume of flushing liquid used during the initial pulse is at least three times the internal volume of the filter elements.

20. A process as claimed in Claim 19, wherein the volume of flushing liquid used during a second pulse is less than that used during the initial pulse.

21. A process as claimed in any one of Claims 10 to 20 inclusive, wherein the pressure differential across the filtering media and filter cake during backflushing is up to 10 bar depending on the degree of clogging or age of the filtering media.

22. A process as claimed in any one of Claims 10 to 21 inclusive, wherein the flushing liquid flow rate is at least 6000  $\ell/h/m^2$  of filtering media.

23. A process as claimed in any one of Claims 10 to 22 inclusive, which includes subjecting the filter elements to a waiting period during which no filtering or backflushing takes place, so that there is then thus no liquid flow through the filtering media of the elements, to enhance subsequent filtration.

24. A process as claimed in any one of Claims 8 to 23 inclusive, which includes agitating the slurry in the slurry bed, to inhibit settling of catalyst particles.

5 25. A process as claimed in Claim 24, wherein the agitation includes allowing slurry in the slurry bed to pass downwardly from a high level to a lower level, through at least one downcomer.

10 26. A process as claimed in Claim 25, which includes operating the vessel such that the slurry bed is in a heterogeneous or churn-turbulent flow regime and comprises a dilute phase consisting of fast-rising large bubbles of gaseous reactants, and possibly gaseous products, which traverse the reaction zone or slurry bed virtually in a plug flow manner, and a dense phase comprising liquid product, solid catalyst particles and entrained smaller  
15 bubbles of gaseous reactants and gaseous product.